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BULLETIN

OF THE

CHICAGO ACADEMY OF SCIENCES.

Preliminary Outline

— OF A —

New Classification of the Family Muricidæ

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FRANK COLLINS BAKER

Secretary and Curator.

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PRELIMINARY OUTLINE OF A NEW CLASSIFICATION OF THE FAMILY MURICIDÆ.

BY FRANK COLLINS BAKER.

For several years the writer has been accumulating data bearing upon the natural classification of the Gastropod family Muricidæ. It has been thought desirable to place before students some of the results elucidated, and to invite their friendly criticism.

Of all the groups of Prosobranchiate Mollusks, none are more difficult to naturally classify than this family; the shells and soft parts are so similar in general form, that it is almost impossible to find stable characters upon which to base a sound division into groups. The divisions of most of the old writers are unnatural, having been based on shell characters alone, and in many cases, as in the groups *Phyllonotus* and *Ocinebra*, there has been a hopeless mingling of several distinct forms. Most modern authors have gone to the other extreme, and divided the family into a large number of useless and ill-defined sections, which has only helped to bring the group into still further confusion. The author's aim in the present paper has been simply to place before malacologists the outline of a classification essentially modern and essentially original. It can scarcely be hoped that all will agree with the classification here adopted; but it is hoped that it will be found an improvement over previous systems.

The notes given under each group must not be taken for complete diagnoses. Only the principle characters are given. In diagnosing the genera and subgenera, the following characters must

be taken into account: form of the *shell*, whether with varices or simple foliations, or smooth; form of *operculum* and position of nucleus; form of *animal*, length of proboscis, shape of tentacles and position of verge; character of the *lingual ribbon*, number and position of teeth and denticles.

It is an astonishing fact that of the six hundred and odd valid species of the family, scarcely ten per cent. have been examined for the animal and dentition. It may not be out of place to call attention, right here, to the manner of extracting and mounting the lingual ribbon, as there are a large number of species in which this organ is not known, and knowledge on this subject is much needed. This ribbon, also called the radula, is a strap or belt of chitinous or horny matter, occupying the place in the mouth of the animal analagous to that occupied by the tongue in the vertebrates. The inner end of the radula is secreted by a glandular surface lining a pouch which lies under and behind the cartilaginous and muscular buccal mass upon which the ribbon is carried. The front end of the ribbon is attached to the cuticle. The surface of the radula is set with teeth disposed in rows, transverse and longitudinal; the front rows differ only from those in the rear in maturity; only the first few rows are brought into active use; the rest form a reserve to be called into use when the first have been worn out. The buccal mass is protrusile, and may be readily studied by feeding a snail soft crumbs of bread. In the larger forms, the radula is easily recognized, and can be dissected away with very little trouble. In most of the Murices it is found at the retracted tip of the inverted proboscis. Some of the forms, as the smaller Ocinebras, Typhis and Purpuras, cannot be dissected in the ordinary way, and must be boiled in caustic potash. This is accomplished as follows: extract the animal from its shell, place in a test tube containing about a tablespoonful of caustic potash which has attracted the atmospheric moisture until it has become liquid. Take the test tube between a pair of forceps, and hold it at the side of the flame of an alcohol lamp until it boils, being careful not to let it boil over. Be very careful that the animal matter is not thrown out of the liquid on to the dry side of the tube. Should this happen, dislodge it by shaking the liquid over it. Boil slowly until all the animal matter is dissolved; then

pour it out quickly into a watch crystal, refill the test tube with water and pour into another watch crystal. Give the first crystal a rotary motion, not too violent, so as to bring the solid particles to the center. Examine with a powerful hand lens; a sheet of white paper under the watch crystal will greatly aid in discovering the radula. This will be recognized by its curved, elongate shape and apparently reticulated surface. If the radula is not found in the first crystal, examine the second. When found, in either one of the two crystals, transfer to a glass slide and examine under the microscope with powers ranging from one inch to one-eighth inch. It had best be examined by transmitted light.

After examining and sketching the form of the radula, it will be necessary to tear the ribbon up so as to get separate rows and individual teeth, since they lie over one another like shingles on a roof. The whole of one tooth cannot always be seen under one focus, because the recurved cusps of the teeth are higher than the base. When the teeth are very transparent, it will be found necessary to stain the radula. To do this, first carefully clean the radula, then put it in a drop of strong solution of chromic acid; this stains it yellowish brown. It may then be mounted temporarily in glycerine jelly, or permanently in Canada balsam.

The teeth are disposed upon the radula in three principal longitudinal rows, which are easily distinguished. There is always one median longitudinal row of unpaired teeth, with a single row on either side. The central tooth is called the median or *rhachidian* tooth. The teeth on either side are called *uncini*. In describing the teeth, note should be made of the form of the base of attachment, especially in the rhachidian; also other special characteristics such as simple, straight, curved or compound. Each tooth (as the rhachidian) may be made up of a number of projections called cusps, and great care should be used in describing and sketching these. In describing the teeth, we use a dental formula to express the number and situation of the teeth and cusps; thus, if a radula has a single rhachidian and one uncinal tooth on each side, and the rhachidian tooth has five cusps, we would express the formula as follows:

$$1 + \tfrac{1}{5} + 1.$$

The unit representing the tooth is written as a numerator and the number corresponding to the cusps as a denominator. In the example given, the uncini are long and prong-like and the cusp number is omitted. This is the case with all the Muricidæ. Careful drawings should always be made of both teeth and cusps, as well as accurate descriptions.

In describing the animal the following points should be carefully noted: shape and size of foot and position of operculum, with any peculiarities of same; shape of tentacles and position of eyes on same; size and shape of proboscis (if measurements are taken they should be in millimetres) size, shape, and position of verge (penis); color of animal, whether spotted or uncolored; size and shape of siphon occupying anterior canal. In the operculum the following points should be noted: size, shape and color, position of nucleus and surface sculpture, whether smooth or straight. In describing the shell, every point should be taken into consideration, such as size, number of varices, spiral and longitudinal sculpture, embryonic apex, size of aperture and condition of outer lip—simple, plicate, or dentate—anterior canal, whether long or short, open or closed, straight or curved; color, etc., etc.

In the following classification I have taken advantage of every character—shell, animal, operculum and radula. In my opinion, no one character can be picked out and used to the exclusion of all others, in any classification. Many of the older authors depended wholly upon conchological characters, and the result has not been at all satisfactory. In the following pages a number of groups are diagnosed in which some of the characters are not known (at least to me), and should any reader of this paper possess such information—either from original observation or from some publication unknown to me,[1] it would be greatly appreciated.

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1. The principal authorities consulted are the following:

Adams, H. & A., Genera of Recent Mollusca.
American Journal of Conchology.
Annals and Magazine of Natural History.
Baker, Frank C., Proc. Acad. Nat. Sci. Phil., 1889-1891.
Boston Journal of Natural History.
Bronn and Keferstein, Klassen und Ordnungen der Weichthiere.
Dall, W. K., numerous papers in Bull. Mus. Comp. Zool. Harvard College, and Proc. and Bull. U. S. Nat. Museum.

Primarily the Murices are divisible into three groups, as follows:

a. Shell canaliculate; whorls crossed by spinose or foliated varices; operculum ovate, with subapical or apical nucleus; verge narrow, club shaped, generally straight, but sometimes curved; dentition: the rhachidian tooth with but few cusps generally; formula as a rule, $1 + \frac{1}{5} + 1$.

SUBFAMILY I. MURICINÆ.

b. Shell with short canal or a simple notch; whorls ribbed, nodulous, or smooth; columella broad and flattened; operculum oblong, with lateral nucleus; verge thick, curved, tapering; dentition: the rhachidian tooth with (generally) numerous cusps, formula ranging from $1 + \frac{1}{3} + 1$ to $1 + \frac{1}{17} + 1$.

SUBFAMILY II. PURPURINÆ.

c. Shell with short canal; ribbed or frilled, scabrous; when adult free, or forming more or less irregular extensions of the outer and inner lips; living in coral; operculum ovate, nucleus sublateral, sometimes wanting; verge straight, swollen, club shaped; radula wanting (?)

SUBFAMILY III. CORALLIOPHILINÆ.

Fischer, Manual de Conchyliologie.
Journal de Conchyliologie.
Küster, Systematischen Conchylien Cabinet.
Lischke, Japanische Meeres Conchylien.
Malakozoologische Blätter.
Nachrichtsblatt der deutschen malakozoologischen Gesellschaft; also Jahrbücher of the same.
Nouvelles Archives du Museum.
Proc. Royal Society of Tasmania.
" Linn Soc. New South Wales.
Say, Thomas, complete writings (By W. G. Binney.)
Troschel, Das Gebiss der Schnecken.
Tryon, Geo. W., Jr., Manual of Conchology.
Verrill, A. E., numerous papers in Trans. Conn. Acad. Sciences, and Report U. S. Fish Commission.
Watson, R. Boog, Mollusca of Challenger Expedition. In "Challenger Reports."
Also numerous scattered papers in different Proceedings and Transactions.

Subfamily I. MURICINÆ.

The principal characteristics of this group are, the spiny or nodulous varices and long canal; operculum with terminal initial point, a long, narrow, and club shaped verge, and a distinct muricoid dentition. There are, however, on the confines of this group, species which seem to partake of the characters of both *Murex* and *Purpura*, as certain forms of *Ocinebra*, *Urosalpinx* and *Trophon*. It is difficult, therefore, to draw up a diagnosis which will include all of one group to the exclusion of all others.

Genus Murex Linné, 1758.

Shell ovate or oblong; spire always prominent, whorls rounded, crossed by three or more spinose or foliated varices; canal long or short, always distinct, partly open.

Animal with a large, broad foot; tentacles long and tapering, the eyes situated on the outside, near the end; proboscis cylindrical, long; verge long, club shaped, situated on the right side behind the tentacle.

Operculum ovate, with subapical nucleus.

Dentition $1 + \frac{1}{5} + 1$; the lateral cusps of the rhachidian tooth very large, the next two very small, and the central cusps very large; base of rhachidian tooth quadrate, uncini with single cusps, long and prong-like.

Type. Murex tenuispina, Lam.

Subgenus Murex (typical).

Shell more or less pyriform, spinose, with three varices; whorls rounded, crossed by distinct spiral lines; spire elevated; canal very long, nearly straight, partly closed; aperture ovate, the outer lip sometimes toothed.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex tenuispina, Lam.

Section Haustellum Klein., 1753.

Shell differs from Murex (typical) in the absence of spines, in the aperture being nearly circular, and in the canal being closed. Spire more compressed.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex haustellum, Linné.

Subgenus Bolinus[2] Peusch, 1837.

Shell ovate-pyriform, spinose, with six varices; whorls rounded, spiral sculpture very fine; spire depressed; canal very long, straight, nearly closed; aperture ovate, the outer lip simple; varices very large and strong.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex brandaris, Linné.

Subgenus Chicoreus Montf., 1810.

Shell ovate-pyriform, with three varices, foliated, seldom spinose; whorls rounded, spiral sculpture generally very strong; spire elevated; canal short, curved, wide, nearly or quite closed; aperture ovate, outer lip simple.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex palma-rosæ, Linné.

Subgenus Homalocantha Mörch, 1852.

Shell ovate-pyriform, with from five to eight varices; varices foliated and produced into peculiar expanded digitations; whorls rounded, sutures very deep; spire but little elevated; canal rather long, nearly straight and almost closed; aperture ovate, outer lip crenulated.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex scorpio, Linné.

Subgenus Phyllonotus Swainson, 1840.

=*Muricantha*, Swanison, 1840.

Shell broadly-ovate, with from four to fifteen scaly or foliated varices; whorls rounded, spiral sculpture well developed; spire ranging from depressed to considerably elevated; canal of moderate length, curved, nearly closed; aperture ovate, outer lip crenulated.

Animal, *operculum* and *dentition* as in *Murex*.

Type. Murex radix, Gmelin.

Subgenus Pteronotus Swainson, 1840.

Shell triangular, with three varices; varices fin-like or foliated; whorls rounded; spire elevated; canal moderately straight or somewhat curved, nearly closed; aperture oblong-ovate, the outer lip generally simple, but sometimes crenulated.

Animal, *operculum* and *dentition* as in the genus.

Type. Murex pinnatus, Wood.

[2]This name should take precedence over that of Rhinocantha, H. and A. Adams, published in 1853.

Genus EUPLEURA[3] H. and A. Adams, 1853.

Shell Ranelliform, with two lateral varices, and from four to twelve intermediate smaller varices; the lateral varices are sometimes not developed, and in these cases the shell is equi-varicose; varices foliated; whorls rounded; spire elevated; canal rather long, nearly straight, partly closed; aperture ovate, dentate within.

Animal with a short, rounded foot, truncate behind; tentacles long, tapering from base to tip, with the eyes about midway; verge on the right side, behind the tentacle, turned back in a curve, compressed at base, rounded and blunt at the tip.

Operculum like that of *Murex*.

Dentition $1 + \frac{1}{9} + 1$, the three lateral cusps of the rhachidian tooth very small, the three central cusps very large; the single-cusped uncini long, narrow and hooked.

Type. EUPLEURA CAUDATA, Say.

Genus XANTHOCHORUS[4] Fischer, 1884.

Shell broadly-ovate, thick, heavy; whorls rounded; varices numerous, fimbriated, crossed by from six to ten revolving ribs, the interstices crowded with incised revolving lines; spire not much elevated; canal very short, open, straight; umbilicus open; outer lip thick, dentate within.

Animal with a short, wide foot, rounded behind, truncate before; tentacles long, tapering from base to tip; eyes on prominences at the base of the tentacles; verge large and swollen, situated on the right side behind the tentacle; proboscis of medium size, cylindrical.

Operculum muricoid.

Dentition $1 + \frac{1}{3} + 1$; the three central cusps of the rhachidian tooth large and equal in size; uncini long, slender, pointed.

Type. XANTHOCHORUS XANTHOSTOMUS, Brod.

Genus FORRERIA[5] Jouss., 1880.

Shell pyriform, thick and heavy; whorls triangular, with numerous semi-foliated varices; no spiral sculpture; spire not much elevated; canal of moderate length, open, straight; umbilicus large, open; aperture long-ovate, outer lip with a tooth at the base.

Animal resembling that of *Purpura*.

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[3] In removing this genus from the vicinity of *Urosalpinx* to its present location, my position is fortified by the opinion of Mr. W. H. Hall, Mr. Chas. Simpson, and others. The shell is decidedly like *Pteronotus* and the operculum is the same as that of *Murex*.

[4] The thick and heavy shell, dentate lip and operculum, are, in my opinion, characters sufficiently marked to place this section in its present position as a genus.

Operculum purpuroid.

Dentition $1 + \frac{1}{3} + 1$, the three cusps of the rhachidian tooth equal in size, triangular in shape, and very sharp, like the teeth of a saw; uncini curved and hook-like, very broad.

Type. FORRERIA BELCHERI, Hinds.

Genus TROPHON Montfort, 1810.

Shell fusiform or broadly-ovate, thick or thin, whorls rounded or shouldered; umbilicus open or closed; varices numerous, sharply laminated, the interstices smooth or spirally ribbed; spire usually elevated, canal moderate, open, generally turned to the left; aperture oblong-ovate or rounded, outer lip thin or thick, smooth or dentate within.

Animal with a short, rounded foot; tentacles long, tapering from base to tip, with the eyes situated on prominences near the base; proboscis of medium size, cylindrical.

Operculum of the purpuroid type, with an apical or sub-lateral nucleus.

Dentition $1 + \frac{1}{1} + 1$, $1 + \frac{1}{5} + 1$, or $1 + \frac{1}{3} + 1$, the central cusp of the rhachidian tooth very large, and in the case of the five and seven cusped rhachidians, a large cusp alternates with a small one; uncini long and fang-shaped.

Type. TROPHON GEVERSIANUS, Pallas.

Subgenus TROPHON (*sensu stricto*).

Shell broadly-ovate, rounded or strongly shouldered, with numerous sharp, laminated varices, the interstices smooth or spirally ribbed; spire elevated; canal short, open, nearly straight; aperture rounded, outer lip simple, umbilicus open.

Animal as in the genus.

Operculum variable; the growth being lateral, causing the nucleus to appear as if on the outer side instead of the lower extremity, thus resembling that of *Purpura*.

Dentition $1 + \frac{1}{3} + 1$, the cusps of the rhachidian tooth very large and equal in size; uncini long and pointed.

Inhabits Antarctic seas.

Type. TROPHON GEVERSIANUS, Pallas.

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[5] This form has usually been classified under the genus *Chorus*, Gray, but the type of that genus is the *Monoceras giganteum* of Lesson. It was placed in *Trophon* as a section by Fischer, but I believe the better disposition to be as a separate genus, between *Xanthochorus* and *Trophon*.

Subgenus Boreotrophon Fischer, 1884.

Shell fusiform, rather thin; whorls rounded or distinctly shouldered, crossed by numerous laminated varices; spire elevated; canal long, straight or slightly curved, open; umbilicus closed; aperture ovate or rounded, outer lip simple or crenulated.

Animal as in the genus.

Operculum elongated, acute, with a nearly apical nucleus.

Dentition $1 + \frac{1}{5} + 1$, or $1 + \frac{1}{7} + 1$, the central cusps of the rhachidian tooth very long and pointed, the lateral cusps of uneven size; uncini long and prong-like, as in the genus.

Boreal in distribution.

Type. Trophon clathratus, Linné.

Section Trophonopsis[6] B. and D., 1882.

Shell differing from *Boreotrophon* in being more regularly fusiform, with more numerous varices.

Animal with a longer foot and tentacles, the eyes situated on swellings near the base.

Operculum as in *Boreotrophon.*

Dentition $1 + \frac{1}{5} + 1$, the cusps as in *Boreotrophon.*

Type. Trophon muricatus, Mont.

Subgenus Aspella Mörch, 1877.

Shell fusiform, with a tendency toward lateral compression; whorls rounded, varices numerous; spire elevated; canal short, recurved, always open; aperture denticulate in the adult; nucleus small, at first obliquely and loosely wound, like a stranded rope, having a strong resemblance to a reversed nucleus.

Animal with a large foot, rounded behind, double edged in front, auriculated in the anterior corners; proboscis moderately long; tentacles small, close together, the eyes situated on their outer sides, half way between base and tip.

Operculum elongated, acute, with an apical nucleus.

Dentition $1 + \frac{1}{5} + 1$, resembling that of *Phyllonotus.*

Type. Trophon anceps, Lam.

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[6] It is with some doubt that I make this group a distinct section. It is altogether too nearly related to *Boreotrophon.* The shell, however, shows some differential characters, and it may be found convenient, at least, to retain the group as a section of *Boreotrophon.*

Genus Ocinebra Leach, 1847.

Subgenus Ocinebra (*sensu stricto*).

Shell fusiform, with from three to fourteen varices; varices rounded; umbilicus closed; spire elevated; canal moderate, open or closed, turned to the left; aperture round or ovate; outer lip dentate within.

Animal with a small, narrow foot, rounded in front, pointed behind; tentacles long, slender, tapering; eyes on long stalks exterior to and united with the tentacles for two thirds of their length; verge situated on the right side, behind the tentacles.

Operculum like that of *Murex*, with the nucleus anterior, but not apical, and somewhat laterally situated.

Dentition $1 + \frac{1}{1}\frac{}{3} + 1$, the three central cusps of the rhachidian tooth large, the others smaller; uncini long and pointed.

Type. Ocinebra erinaceus, Linné.

Section Crassilabrum Jouss., 1880.

Shell broadly-ovate, with numerous varices; varices thick and cord-like, crossed by several equally thick spiral cords, giving the shell a latticed aspect; umbilicus closed; spire elevated; canal short, open, nearly straight.

Animal as in *Ocinebra* (*s. s.*)

Operculum and *dentition*, unknown to me.

Type. Ocinebra crassilabrum, Gray.

Section Ocinebrina Jouss., 1880.

Shell fusiform, with numerous rounded varices (ribs) crossed by strong spiral lines; spire elevated; canal short, open, straight; aperture ovate, outer lip dentate within.

Animal with a small, narrow foot, rounded before, pointed behind; tentacles long, slender, tapering, microscopically ciliated, especially at the blunt tips; eyes and verge as in *Ocinebra* (*s. s.*)

Operculum of the purpuroid type.

Dentition $1 + \frac{1}{1}\frac{}{3} + 1$, the central cusp of the rhachidian tooth very large, the lateral series with a large cusp at each end, and smaller ones in between; uncini long and prong-like.

Type. Ocinebra aciculatus, Lam.

Subgenus Favartia Jouss., 1880.

Shell fusiform, with numerous rounded varices, crossed by raised spiral lines; umbilicus closed, spire elevated, canal moderate, nearly closed; aperture rounded, outer lip slightly plicate within.

Animal as in *Ocinebra.*

Opeculum ovate or rounded, with apical nucleus.

Dentition unknown to me.

Type. Ocinebra brevicula, Sowb.

Subgenus Pterohytis[7] Conrad, 1862.

=*Cerastoma* Conrad, 1837.

Shell fusiform, ovate or pyriform, with three foliated or fin-like varices, spire moderately elevated; no umbilicus; canal short, straight, closed; aperture oblong-ovate, outer lip dentate within, with a produced tooth near its base.

Animal as in *Ocinebra.*

Operculum ovate, with lateral nucleus.

Dentition muricoid.

Type. Ocinebra nuttallii, Conr.

Genus Vitularia Swainson, 1840.

Shell oblong, with numerous, nearly obsolete varices; no distinct spiral sculpture; umbilicus open or closed; spire elevated; canal short, straight, open; aperture a long oval, outer lip strongly dentate within.

Animal as in *Ocinebra.*

Operculum oblong, smaller than the aperture, rather thin, nucleus lateral.

Dentition unknown to me.

Type. Vitularia salebrosa, King.

Genus Muricidea (Swains.) Mörch, 1840.

Shell fusiform, with numerous spiny varices or rounded ribs; umbilicus closed; spire elevated; canal moderate, open, curved; aperture oblong or rounded, outer lip generally plicate within.

Animal as in *Murex.*

Operculum resembling that of *Fusus,* ovate, with apical nucleus.

Dentition unknown to me.

Type. Muricidea hexagona, Lam.

[7]The name *Cerastoma* was used by Labrille, in 1802, for an apparently valid genus of *Lepidoptera.* The only course to be adopted is to accept Conrad's name proposed in 1862 for a group of fossil Murices, closely related to *Cerastoma.*

Genus Urosalpinx Stimpson, 1865.

Shell short-fusiform, with numerous longitudinal ribs, crossed by raised spiral lines; umbilicus closed; spire elevated; canal short, open, curved; aperture oval, outer lip dentate or lirate within.

Animal small, foot scarcely large enough to fill the aperture; head scarcely protruded; tentacles nearly united at their base, tapering to a mere filament; eyes situated at upper third of the tentacle, on the outside. Verge as in *Murex*.

Operculum externally like *Murex;* semi-cordate, with the nucleus at the outer edge, a trifle below the middle; internally showing gyratory scars as in *Purpura*.

Dentition $1 + \frac{1}{5} + 1$, the rhachidian tooth with numerous minute denticles between the principal cusps; uncini long and prong-like.

Type. Urosalpinx cinereus, Say.

Genus Typhis Montfort, 1810.

Shell pyriform or oblong, with four varices;[8] umbilicus scarcely visible; whorls shouldered, with projecting hollow tubes continuous with or between the varices; spire depressed; canal moderate, closed, nearly straight, aperture sub-orbicular.

Animal resembling *Murex*. The ascending tube (this is at first not a hollow cylinder, but a fold of the mantle) is occupied by an extension of the mantle margin. Foot long and narrow; tentacles thick and broad; eyes situated at their base.

Operculum ovate, with sub-apical nucleus, like that of *Murex*.

Dentition unknown to me.

Type. Typhis tetrapterus, Bronn.

Section I. Typhis (Typical).

Ascending tube placed between the varices.

Animal, *operculum* and *dentition* as in the genus.

Type. Typhis Tetrapterus, Bronn.

Section II. Trubatsa Dall, 1889.

Ascending tube continuous with varices.

Animal, *operculum* and *dentition* as in the genus.

Type. Typhis longicornis, Dall.

[8]Notwithstanding the fact that this genus has been described as three-varicose by almost every monographer, I maintain, and so will all who will examine *carefully* a specimen, that it is four-varicose. I may add that I have never seen a specimen with three varices, either fosil or recent.

SUBFAMILY II. PURPURINÆ.

The principal characters of this group are, the short, merely notched canal, the comparatively smooth whorls (in some species nodulous, however), the broad and fattened columella, operculum with lateral nucleus, and rhachidian tooth of the radula with numerous dentacles. The same rule applies to this group, as that spoken of under *Muricidæ*.

Genus PURPURA Brug., 1789.

Shell oblong-oval, whorls smooth or nodulous; last whorl very large; spire generally short; aperture ovate, very large; canal short, oblique, often a mere notch; columella flattened; outer lip generally simple, sometimes lirate.

Animal with a large foot, truncate in front, pointed behind (the foot is not as large, comparatively, as in *Murex*); head very distinct; tentacles sometimes placed on stalks near the base; siphon generally short; verge as in *Murex*.

Operculum ovate or elongate, with lateral nucleus, showing on the interior gyratory scars.

Dentition $1 + \frac{1}{5} + 1$ to $1 + \frac{1}{9} + 1$; the three central cusps very large, the lateral cusps very small; uncini long and fang-like.

Type. PURPURA PERSICA, Linné.

Subgenus PURPURA[9] (Typical).

Shell oblong oval, whorls smooth; last whorl very large, occupying three-quarters of the length of the shell; spire short; aperture ovate, flattened; outer lip lirate within.

Animal and *operculum* as in the genus.

Dentition $1 + \frac{1}{5} + 1$, the middle cusp of the rhachidian tooth very long, the middle side cusps small, and the lateral cusps larger; uncini long and pointed.

Type. PURPURA PERSICA, Linné.

Subgenus PURPURELLA Dall, 1872.

Shell oblong-oval, whorls covered by rounded nodules; last whorl very large; canal a mere notch, spire depressed; aperture ovate, outer lip dentate within; columella flattened, with one or two distinct spiral ridges upon its center, extending from columella to apex.

Animal and *operculum* as in the genus.

Dentition as in *Purpura*.

Type. PURPURA COLUMELLARIS, Lam.

[9] Hutton (P. N. Z. Inst., vol. XVI, 1883) has diagnosed a new genus (*Lepsia*) for *Purpura haustrum*, Martyn, but I can see no really distinctive characters by which to separate it from *Purpura* (typical).

Subgenus Tribulus Klein, 1753.

Shell oval, whorls nodulous; last whorl very large, ventricose; aperture very wide, ovate; inner lip excavated, corrugated at the fore-part; outer lip dentate within; canal very short; spire depressed.

Animal and *operculum* as in the genus.

Dentition $1 + \frac{1}{1}\frac{1}{1} + 1$, the three central cusps of the rhachidian tooth very large and prong-like, with a small denticle between, the three lateral denticles very small; uncini long and fang-like.

Type. Purpura planospira, Lam.

Subgenus Thalessa H. and A. Adams, 1853.

Shell ovate or pyriform; whorls smooth or nodulous; angulated at the upper part; spire elevated; aperture occupying half the length of the shell, ovate; columella rounded, tubercular in front; canal a mere notch; outer lip nodulous within.

Animal resembling that of *Purpura*, but foot smaller and longer.

Operculum as in *Purpura*.

Dentition $1 + \frac{1}{9} + 1$, the central cusp of the rhachidian tooth very large, the next two large and bifid; lateral cusps very small; uncini long and pointed.

Type. Purpura hippocastaneum, Linné.

Subgenus Stramonita Schum., 1817.

Shell ovate; whorls simple or nodulous; spire elevated; aperture moderate, produced anteriorly; columella rounded, simple in front; canal short; outer lip lirate within.

Animal and *operculum* as in *Purpura*.

Dentition $1 + \frac{1}{9} + 1$, $1 + \frac{1}{1}\frac{1}{1} + 1$, the cusps of the rhachidian tooth as in *Thalessa*. Uncini as in the preceding groups.

Type. Purpura hæmastoma, Linné.

Subgenus Trochia Swains., 1840.

Shell ovate; whorls crossed by numerous raised spiral lines or ribs, and separated by deep grooves; spire usually elevated; aperture moderate; canal short; columella rounded, slightly excavated near the base; outer lip thickened, convex, lirate within.

Animal and *operculum* as in the genus.

Dentition as in *Thalessa*.

Type. Purpura cingulata, Linné.

Subgenus Polytropa Swains., 1840.

Shell a long oval; whorls foliated or tuberculose; spire acuminate; aperture rounded, narrowed at the fore part; canal short, oblique; columella arcuate; outer lip smooth or lirate within.

Animal with a small foot; other characters as in the genus.

Operculum as in *Purpura*.

Dentition $1 + \frac{1}{5} + 1$, the cusps of the rhachidian tooth large and of equal size; uncini as in *Purpura*.

Type. Purpura lapillus. Linné.

Subgenus Cronia H. and A. Adams, 1853.

Shell long-ovate; whorls crossed by raised spiral lines; spire acuminate; aperture long-ovate, moderate; canal very short; inner lip with a callous at the upper part; columella straight, simple anteriorly; outer lip dentate or lirate within.

Animal and *operculum* as in the genus.

Dentition unknown to me.

Type. Purpura amygdala, Kiener.

Subgenus Agnewia[10] Tenison-Woods, 1877.

Shell long-ovate, inclining to fusiform; whorls ribbed or nodulous; spire acuminate; aperture small, rounded; canal a mere notch; columella arcuate, smooth; outer lip lirate within.

Animal and *operculum* as in *Purpura*.

Dentition unknown to me.

Type. Purpura typica, Dunker.

Genus Rapana Schum., 1817.

Shell ventricose, axis perforated to the apex; whorls angulated at the shoulder; spire depressed; aperture oval, narrowed anteriorly, canal short, open, slightly recurved; inner lip reflected, free anteriorly; umbilicus wide, corrugated; outer lip smooth or very slightly lirate within.

Animal and *operculum* resembling that of *Purpura*.

Dentition $1 + \frac{1}{13} + 1$, the central cusp of the rhachidian tooth very large, the two on either side large, and strengthened by several small denticles; lateral cusps small; uncini long and fang-shaped.

Type. Rapana bulbosa, Solander.

[10]Dunker characterized the genus *Adamsia* in 1856; but this name being preoccupied by E. Forbes in *Anthozoa*, Rev. E. Tenison-Woods. in 1877, changed the name to *Agnewia*. The genus has been placed in *Cominella* and *Urosalpinx*, but its proper place is, I believe, in *Purpura*.

Genus CYMIA[11] Mörch, 1877.

Shell short fusiform; whorls strongly angulated in the middle; spire elevated; aperture ovate; canal short, open; columella with a large plait running clear up to the apex; inner lip reflected; umbilicus open, corrugated; outer lip lirate within.

Animal and *operculum* resembling *Purpura.*

Dentition $1 + \frac{1}{1} + 1$, the central cusp of the rhachidian tooth very large, the next two smaller and bifid, and the lateral cusps very small; uncini long and fang-shaped.

Type. CYMIA TECTUM, Wood.

Genus JOPAS H. and A. Adams, 1853.

Shell ovate; whorls rugose, last large; spire acuminate; aperture moderate; emarginate and channeled in front; columella covered with a thin enamel; with a prominent plait-like callosity near the anterior canal; canal short, open; outer lip sinuous, crenate within.

Animal resembling that of *Purpura;* the foot is long and narrow, truncate before, rounded behind; head distinct; tentacles moderate, tapering, the eyes situated about a third of the distance from the outside; verge as in *Purpura.*.

Operculum purpuroid.

Dentition $1 + \frac{1}{3} + 1$, the central cusp of the rhachidian tooth very large, lateral cusps smaller; uncini long and pointed.

Type. JOPAS SERTUM, Brug.

Genus VEXILLA Swains., 1840.

Shell long-ovate; whorls smooth; spire moderate; aperture very long and narrow; inner lip flattened and depressed; outer lip thickened (in the adult) and dentate within; canal very short.

Animal resembling that of *Purpura;* foot long and narrow, truncate before, rounded behind; tentacles and eyes as in *Jopas.*

Operculum purpuroid.

Dentition unknown to me.

Type. VEXILLA VEXILLUM, Chemn.

Genus PINAXIA H. and A. Adams, 1850.

Shell conical; spire short, acute; whorls smooth, tuberculose on the shoulder; aperture oval-oblong, emarginate anteriorly; inner lip flattened, with several transverse plaits in the middle; outer lip acute, grooved internally; canal very short.

Animal unknown.

Operculum purpuroid.

Dentition unknown.

Type. PINAXIA CORONATA, A. Adams.

[11]The name *Cuma* (Humph, 1797) Swains., 1840, is generally used for this group, but that name is used for a group of Crustacea.

Genus ACANTHINA[12] Fischer, 1807.

Shell ovate, last whorl large, rough or smooth; spire moderate or very short; aperture ovate or semilunar; inner lip wide and flattened; outer lip thick or thin, crenated, with a prominent tooth at the fore part; canal very short, open.

Animal with a short, narrow foot, rounded at both ends; head distinct; tentacles long and tapering, widely separated at their base; eyes placed upon swellings midway between base and tip; siphon of medium size; verge as in *Purpura*.

Operculum purpuroid, triangular.

Dentition $1 + \frac{1}{5} + 1$, the central cusp of the rhachidian tooth triangular; those next triangular and tridentate; the lateral cusps ovate, and smaller; uncini as in *Purpura*.

Type. ACANTHINA IMBRICATA, Lam.

Subgenus CHORUS[13] Gray, 1847.

Shell resembling *Acanthina*, but with longer spire and canal; the shell is smooth, and the tooth on the outer lip very large. It is separated from *Acanthina* chiefly by its pyriform shell.

Animal, *operculum* and *dentition* as in *Acanthina*.

Type. ACANTHINA GIGANTEUM, Lesson.

Genus PENTADACTYLUS[14] Klein, 1753.

Shell ovate, very solid; varices nodulous or scaly; spire very short; aperture linear, narrow, contracted by callous projections; inner lip tubercularly wrinkled; outer lip with plait-like teeth, within digitate; canal short, oblique, open, emarginate in front.

Animal with a rather broad foot; head distinct; tentacles long, thick, separated at base; eyes situated on the outside midway between base and tip; siphon of medium size; verge as in *Purpura*.

Operculum purpuroid.

Dentition $1 + \frac{1}{9} + 1$ to $1 + \frac{1}{13} + 1$, the central cusp of the rhachidian tooth large, triangular, the cusps immediately to right and left bi or trifid, the lateral cusps small and placed like the teeth of a rake; uncini long and fang-like.

Type. PENTADACTYLUS RICINUS, Lam.

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[12]This name has priority over *Monoceras* Lam., 1809.

[13]The type of this genus is not the *Chorus Belcheri* of Hinds (*Forreria*, Jouss.,) but the *Monoceras giganteum* of Lesson.

[14]This name should take precedence over that of *Ricinula*. Lam., 1812. *Morus*., Mont., 1810, is a synonym of *Pentadactylus*, and does not represent the small forms, like *P. morus*, as most authors have written it.

Subgenus MORULA Schum., 1817.

Shell with a longer spire, smaller size and more fusiform than in *Pentadactylus*. The teeth within the outer lip single, not grouped.

Animal resembling *Pentadactylus*. The eyes are sometimes placed on prominences and the foot is narrower.

Operculum as in *Pentadactylus*.

Dentition 1 + $\frac{1}{5}$ + 1, the central cusp of the rhachidian tooth very large, those on either side smaller and bifid, the laterals very small; uncini long and pointed.

Type. PENTADACTYLUS MORUS, Lam.

Genus CONCHOLEPAS Lam., 1801.

Shell ovate, last whorl very large, expanded; spire very short, obliquely inclined toward the left side; aperture very wide, slightly channeled anteriorly; inner lip flattened; outer lip with two small teeth in front.

Animal with a very large foot; head and tentacles as in *Purpura;* eyes placed midway between base and tip of tentacles; siphon moderate; verge as in *Purpura*.

Operculum purpuroid, but entirely too small to fill the aperture.

Dentition 1 + $\frac{1}{5}$ + 1, the central cusp of the rhachidian tooth large and triangular, those on each side large and bifid; lateral cusps very small; uncini long and fang-like.

Type. CONCHOLEPAS PERUVIANUS Lam.

SUBFAMILY III. CORALLIOPHILINÆ.

The principal characters of this group are the short canal, thin, in most cases scabrous shell, and its habit of living in coral; the *operculum*, when present, is ovate with sub apical nucleus; verge straight, swollen, club shaped; radula wanting (?).

Genus RHIZOCHILUS, Steen., 1850.

Shell, when young, free, resembling *Rapana;* when adult, sometimes with more or less irregular solid shelly extensions of the outer and inner lips, which clasp the axis of coral (*Antipathes*); surface of shell rough and scabrous; spire elevated; aperture long-oval; canal rather long, open.

Animal resembling *Latiaxis*.

Operculum none (?).

Dentition not observed.

Type. RHIZOCHILUS ANTIPATHICUS, Steen.

Genus Latiaxis[15] Swainson, 1840.

Shell variable, or pyriform, rough and scabrous; spire very short or much elevated; aperture ovate; canal very short, open; inner lip reflected, smooth; outer lip crenate internally; umbilicus generally open and very wide and deep.

Animal with an oval, moderate foot; head and tentacles distinct, the latter rapidly tapering to a point; eyes sessile, midway between base and tip; verge (?); siphon short.

Operculum resembling *Purpura*, with the necleus lateral.

Dentition not observed.

Type. Latiaxis neritoidea, Lam.

Subgenus Coralliobia, H. and A. Adams, 1853.

Shell differing from *Latiaxis* in being broadly ovate, flattened, and with the outer lip much expanded, concealing the spire.

Animal as in *Latiaxis*.

Operculum wanting (?).

Dentition not observed.

Type. Latiaxis fimbriata, A. Ad.

Genus Leptoconchus Rüppel, 1834.

Shell ovate, thin, last whorl very large; spire very short; aperture semi-lunar; inner lip arcuate, covered with a light callous; outer lip thin, somewhat expanded; no anterior canal.

Animal with a greatly thickened and fleshy mantle margin; tentacles small, broad, and united at their bases; eyes small and black, on the outer side of the tentacles, near their tips; foot small, short, obtuse and rounded behind, with a thin, expanded disc-like lobe in front; siphon obsolete; verge straight, acuminate, swollen, club-shaped at the extremity, placed on the right side of the body.

Operculum wanting.

Dentition not observed.

Type. Leptoconchus cumingii, Desh.

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[15] There has been much confusion over this generic name. I have recently examined several specimens of *Latiaxis mawæ* (Gray), and am firmly convinced that it is but an abnormally loosely coiled specimen of *Coralliophila*. *Pseudomurex*, also, is a synonym; the *operculum* is identical, and the shell characters fade into one another. The synonomy, then, will stand as follows:

Latiaxis Swainson, Man., p. 206, 1840.
Coralliophila, H. & A. Adams, Gen. Rec. Moll., I, p. 135; 1853.
Pseudomurex Monterosato, Conch, Medit., p. 48; 1872.

Genus MAGILUS[16] Montfort, 1810.

Shell when young as in *Leptoconchus*, when adult forming a long tube by the shelly expansion of the outer and inner lips.

Animal as in *Leptoconchus*.

Operculum oval, concentrically laminated, with lateral nucleus.

Dentition not observed.

Type. MAGILUS ANTIQUUS, Lam.

Genus RAPA Klein, 1753.

Shell thin, grobosely pyriform; umbilicus deep, perforating the axis to the apex, the umbilicus partly concealed by the reflected inner lip; spire very short, flat; aperture oblong, produced anteriorly into a wide, sub-recurved canal; inner lip reflected; outer lip thin, crenate.

Animal resembling that of *Leptoconchus*.

Operculum purpuroid, thin and translucent.

Dentition not observed.

Type. RAPA PAPYRACEA, Lam.

GENERA FORMERLY INCLUDED IN THE MURICIDÆ, BUT NOW REFERRED TO OTHER FAMILIES.

Genus PSEUDOLIVA, Swainson. 1840.

=Buccinidæ.

Genus MELAPIUM, H. and A. Adams, 1853.

=Buccinidæ.

Genus MAGILINA, Vélain.

=Vermetus.

[16] LEPTOCONCHUS is separated from *Magilus* on account of the absence of the *operculum* in the former, and in the possession of a long tube in the latter. Should these characters prove stable, after the examination of a large amount of fresh material, then they should most certainly be separated. Many of the species placed in *Leptoconchus* are strongly suggestive of the young of *Magilus* before the tube is formed.